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मानक

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“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 12390 (1988): Iron nickel alloy 36 for ceramic sealing
[MTD 16: Alloy Steels and Forgings]



“ज्ञान से एक नये भारत का निर्माण”

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“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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SPECIFICATION FOR IRON-NICKEL ALLOY 36 FOR CERAMIC SEALING

1. Scope — Covers the requirements of wrought iron-nickel alloy 36 in the form of wires, rounds and strips intended primarily for sealing ceramics and for other applications like electronic components, relays, aircraft controls, optical instruments, metrology instruments, etc. Tubings are not included under this specification.

2. Supply of Material — The general requirements relating to supply of the material shall conform to IS : 1387-1967 'General requirements for the supply of metallurgical materials (first revision)'.

3. Chemical Composition — The chemical composition of the material, when determined by gravimetric or spectrochemical analysis, shall be as follows:

Element	Percent
Nickel*, Nominal	36.0
Carbon, Max	0.03
Manganese, Max	0.35
Silicon, Max	0.20
Chromium, Max	0.25
Cobalt, Max	0.50
Phosphorus, Max	0.025
Sulphur, Max	0.025
Aluminium, Max	0.10
Iron	Remainder

*The nickel percentage indicated is only nominal and shall be suitably adjusted by the manufacturer so that the alloy meets the requirement of thermal expansion indicated in 7.

4. Finish

4.1 The iron-nickel alloy 36 shall be supplied in any of the sizes and finishes indicated in Table 1 and as stated in 4.2 and 4.3.

TABLE 1 FORMS OF SUPPLY, FINISHES AND SIZES

Form	Finish	Size
Wire	Cold drawn Cold drawn and annealed	Diameter: 0.05 to 4.00 mm
Round	Cold drawn Cold drawn, ground Cold drawn, annealed Cold drawn, annealed and ground.	Diameter: above 4 to 12 mm
	Hot rolled Hot rolled, peeled Hot rolled, peeled and centreless ground	Diameter: above 12 to 50 mm
	Hot rolled/forged Hot rolled, forged and turned	Diameter: above 50 mm
Strip	Cold rolled Cold rolled, annealed	Thickness: 0.05 to 4 mm Width: 5 to 225 mm
Sheet	Cold rolled Cold rolled, annealed	Thickness: 0.8 to 4 mm Width: 1 000 mm, Max Length: 3 000 mm, Max

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BUREAU OF INDIAN STANDARDS

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4.2 Lengths of Supply for Wires and Rounds — For thinner gauge wires (0.05 to 0.8 mm diameter), small spools are normally used where total mass of wire not exceeding 1.5 kg of continuous length will be wound.

Diameters

Wires: Above 0.8 to 3 mm

Rods: Above 3 to 10 mm, and
Above 10 to 100 mm

In coils of continuous length of:

10 to 50 kg mass

1 to 3 metres;

Other lengths on specific request by the purchasers

4.3 Straightness — Wires and rounds supplied in cut lengths shall be straight and free from bends and twists. The deviation in straightness shall not be more than 3 mm for a length of one metre.

5. Freedom from Defects

5.1 Iron-nickel alloy 36 supplied in various forms shall be free from scale, corrosion, cracks, seams scratches, slivers and other surface defects. The materials shall be uniform in cross-section, chemical composition, finish and temper.

5.2 All lubricants used in processing shall be thoroughly removed by the manufacturer. Protective coatings present on the material, as shipped, shall be readily removable by any of the common organic solvents such as trichloroethylene.

6. Grain Size — Iron-nickel alloy 36 strip and sheet for deep drawing applications shall have an average grain size of less than 0.065 mm or 16 grains/25.4 mm² of image at a magnification of 100. For material less than 0.13 mm in thickness, the grain size shall be such that there are no less than 4 grains across the thickness.

7. Thermal Expansion — The average linear coefficient of thermal expansion for iron-nickel alloy 36 shall be as indicated in Table 2, when tested with a precision dilatometer in accordance with IS : 3410-1965 'Method of test for determining coefficient of linear expansion of metals at different temperature ranges'.

TABLE 2 THERMAL EXPANSION REQUIREMENTS

Temperature Range, °C	Linear Coefficient of Thermal Expansion, µm/m°C
0 to 50	≤ 1.2
20 to 100	1.2
20 to 150	1.6
20 to 200	2.2
20 to 300	4.6
20 to 400	7.5

8. Porosity — Iron-nickel alloy 36 rounds of diameters higher than 12 mm shall be normally free from porosity when tested in a helium leak detector. Porosity requirements shall be specified by the purchasers only for critical end use applications and this shall be subject to mutual agreement between the manufacturer and the purchaser.

9. Dimensions and Tolerances

9.1 Wires and Rounds — The permissible variation in diameters of wires and rounds shall be in accordance with Table 3.

TABLE 3 PERMISSIBLE VARIATION IN DIAMETERS

Diameter mm		Tolerance mm
0.05 to 0.40	Cold drawn wires in coils	±0.008
0.41 to 1.00		±0.02
1.01 to 4.00		±0.03
4.00 to 12.00	Cold drawn centreless ground rounds	±0.05
12.01 to 25.00	Hot-rolled rounds	±0.10
25.01 to 50.11		±0.25
Above 50.00	Forged rounds	±5.00

9.2 Strips and Sheets — The permissible variation in thickness, width and length of strips and wires shall be in accordance with Tables 4 and 5.

TABLE 4 PERMISSIBLE VARIATION IN THICKNESS OF COLD ROLLED STRIP

Thickness mm	Tolerance on Thickness for Widths Under 225 mm
Under 0.15	±0.02
0.15 to 0.40	±0.03
0.41 to 0.60	±0.04
0.61 to 0.80	±0.05
0.81 to 1.00	±0.06
1.01 to 1.25	±0.07
1.26 to 1.50	±0.08
1.51 to 2.00	±0.09
2.01 to 2.50	±0.10
2.51 to 3.00	±0.12
3.01 to 4.00	±0.15

TABLE 5 PERMISSIBLE VARIATION IN WIDTH OF COLD ROLLED STRIPS AND SHEETS

Thickness	Tolerance for a Given Width of mm		
	4.5 to 12 mm	12 to 150 mm	151 to 225 mm
Under 1.70	±0.13	±0.13	±0.13
1.71 to 2.50	±0.20	±0.20	±0.25
2.51 to 4.00	±0.25	±0.25	±0.41

10. Hardness — Iron-nickel alloy 36 strips and sheets intended for deep drawing applications shall be supplied in cold rolled and annealed condition. The hardness shall not exceed Rockwell B 82 (HV 149) when determined in accordance with IS : 1586-1968 'Methods for Rockwell hardness test (B and C scales) for steels (*first revision*)'.

10.1 Physical and mechanical properties have also been given in Appendix A for information only.

11. Packing and Marking

11.1 Wires and strips supplied in coils shall be wrapped all around with a polyethylene lined hessian cloth. The coils up to 1.5 mm wire diameter shall be packed in wooden cases to avoid damage during transit. Wires of smaller diameter supplied in spools shall be packed in polyethylene bags with small quantity of silica-gel for moisture absorption.

11.2 Rods and sheets supplied in cut lengths shall be covered in hessian and subsequently packed in wooden cases.

11.3 The wooden cases shall be indelibly marked with the manufacturer's name, mass, dimensions, batch number and description of the items.

11.4 The material may also be marked with the Standard Mark. Details are available with the Bureau of Indian Standards.

12. Basis of Purchase — Orders for materials under the specification shall include the following informations:

- Description and size,
- Surface finish,
- Packing and marking, and
- Specification number.

APPENDIX A**PHYSICAL AND MECHANICAL PROPERTIES OF IRON-NICKEL ALLOY 36****(For Information Only)**

<i>Sl No.</i>	<i>Property</i>	<i>Unit</i>	<i>Value</i>
1.	Density	g/cm ³	8.10
2.	Specific heat	k. cal/kg. °C	0.122
3.	Thermal conductivity	k. cal/m.h. °C	11.50
4.	Resistivity	Microhm-m	0.75
5.	Curie point	°C	260
6.	Melting point	°C	1420
*7.	0.2 percent proof stress	MPa	380
*8.	Tensile strength	MPa	490
*9.	Elongation on 50 mm gauge length	Percent	36
*10.	Hardness	HV	135-165

*Properties in annealed condition.

WELDABILITY

This alloy can be welded by MIG, TIG, plasma and resistance welding. The filler rod should be preferably of the same composition for obtaining optimum joint characteristics. Heavily coated 18-8 stainless steel or mild steel filler rods can also be used. The welded parts shall be stress relieved by annealing them at 350°C for 2 hours.

EXPLANATORY NOTE

Iron-nickel alloy 36 is a controlled expansion alloy for ceramic sealing having a lowest thermal expansion of approximately one tenth that of carbon steel up to 200°C. The important characteristics of this alloy are uniform magnetic and mechanical properties, low coercive field strength, controlled thermal expansion and low contents of non-metallic inclusions. This alloy finds applications in electronic components, relays, aircraft controls, optical instruments, cryogenic parts, metrology instruments, precision pendulums, temperature regulators and thermostatic bimetal strips. This alloy is recommended for use where the continuous operating temperature does not exceed 200°C.

This standard has been prepared as a guide to the manufacturers and users of iron-nickel alloy 36 which is familiarly known as INVAR. In the preparation of this standard, necessary assistance has been derived from TGL 24329-1984 Controlled Expansion Alloys Semiconductors.